A FLOOD PLAIN MANAGEMENT STUDY

For the Town of Thetford, Vermont

PREPARED IN COOPERATION WITH

- Town of Thetford
- White River Natural Resources Conservation District
- Vermont Department of Environmental Conservation

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

FOREWORD

The Soil Conservation Service, U.S. Department of Agriculture, prepared the information in this flood plain management report. Officials of the Vermont Agency of Natural Resources and Department of Environmental Conservation, the White River Natural Resources Conservation District, and the Town of Thetford cooperated in compiling the report.

The flood hazard and land use information should serve as a technical base for flood plain management programs. State and local governments, as well as the public, will benefit from knowledge of flood information on the Ompompanoosuc River and its tributaries. A program to minimize future flood damages can be developed from this information. Describing the legal aspects and methods of conducting management programs is not within the scope of this report. However, some general recommendations are included.

We thank the many people who contributed information for the study. We also thank the landowners who gave permission for field surveys.

TABLE OF CONTENTS

FLOOD PLAIN MANAGEMENT STUDY
TOWN OF THETFORD
ORANGE COUNTY, VERMONT

Introduction

The Vermont Agency of Natural Resources (VT-ANR), the Town of Thetford, and the White River Natural Resources Conservation District (NRCD) coordinated in this flood plain management study and report preparation. The VT-ANR provided overall coordination for the study and assisted with the field surveys. The Town of Thetford has provided public participation, made necessary arrangements for field surveys, provided base maps, and duplicated and distributed this report. The NRCD has also cooperated in the effort.

The state and local entities requested the flood plain management study to provide detailed flood frequency characteristics and other analyses for a major portion of the flood plain system within the Town of Thetford. The town was experiencing increasing pressures for development of flood prone areas and lacked detailed flood plain information.

The U. S. Department of Agriculture, Soil Conservation Service (SCS) participated in the study and preparation of this report under the authorities of Section 6, Public Law 83-566, as amended; Executive Order 11988, Flood Plain Management, dated May 24, 1977; Recommendation 3, a Uniform National Program for Flood Plain Management, Water Resources Council, September 1979; and U. S. Department of Agriculture's Secretary's Memorandum Nos. 1606 and 1607, November 7, 1966.

The Vermont Department of Environmental Conservation, a department within the VT-ANR, is responsible for making studies, policies, and plans for the use, development, and protection of Vermont's water resources under Chapter 37, Title 10, of the Vermont Statutes Annotated.

This report provides a description of the flood plain system including its natural values, flood-frequency-stage-inundation relationships, and alternatives for flood plain management consideration.

Study Area Description

The Ompompanoosuc River Watershed is located in east central Vermont in the Connecticut River basin (Hydrologic unit number 01080103040).

It has a drainage area of about 87,000 acres and includes parts of ten towns: Norwich, Sharon, Thetford, Strafford, West Fairlee, Fairlee, Vershire, Tunbridge, Chelsea, and Corinth. The main populated areas are West Fairlee, Post Mills, Thetford Center, Union Village, South Strafford, and Strafford with a combined population of about 3,500 people.

The headwaters of Ompompanoosuc River begin at the Piedmont Foothills of Strafford, Tunbridge, Chelsea, Vershire, Corinth, and West Fairlee and flow in an easterly direction emptying into the Connecticut River. The watershed has several lakes and ponds. They include Lake Fairlee (463 AC), Miller Pond and Lake Abenaki. The river has numerous tributaries with the principal streams being Algerine Brook, Middle Brook, Blood Brook, Barker Brook, Avery Brook, Jackson Brook, Lord Brook, Abbot Brook, Downer Brook, Old City Brook, Clover Hill Brook, and Drew Cemetery Brook.

This report provides detailed information on 1.4 miles of the West Branch of the Ompompanoosuc River, 1.8 miles of the Ompompanoosuc River and 0.4 miles of the Ompompanoosuc River downstream of the Union Village dam, within the town of Thetford, Vermont. The Sheet Index Map provides locations of these studied stream reaches. The drainage areas of the West Branch of the Ompompanoosuc River, the Ompompanoosuc River and the Ompompanoosuc River downstream of the dam, in this study are 57.0, 59.6 and 130 square miles respectively.

The Village of Thetford Center is located at 43° - 50′ north latitude, 72° - 15′ longitude. It has a cool, humid climate. Average annual precipitation is 36 inches, which includes an average of 75 inches of snowfall. The mean annual temperature is 41° F with a winter minimum of -29° F and a summer maximum of 94° F.

Natural and Beneficial Values

The Vermont State water quality classification is Class B for both branches of the Ompomanoosuc River and all of its major tributatiries in the Town of Thetford. This designation implies that the waters are suitable for bathing, recreation, fish habitat, irrigation, and public water supply with filtration and disinfection. Generally, Class B waters also have good aesthetic values. No significatn degradation in water quality has been identified on either branch of the river and no aquifer protection areas have been delineated in Thetford.

The river and waterbodies in the town provide a wide range of recreational opportunities. There is good canoeing and kayaking on the river fromn West Fairlee down to the Thetford Covered Bridge. The canoeing and kayaking occurs primarily during spring runoff and provides intermediate white water boating for about 8.0 miles of river. Lake Fairlee, and to a limited extent Lake Abenaki, provide additional recreational opportunities such as boating, swimming, and fishing. Lake Fairlee also supports a number of summer residents along its shore.

The Ompompasoonuc River and its tributaries provide many miles of good quality fishing. The main branches of the river support rainbow and brown trout while the smaller tributaries support native brook trout populations. In addition to trout, small-mouthed bass, pickerel, and bullhead are found in the lakes and ponds of the town.

Currently underway is an inter-agency project to restore Atlantic salmon to the connecticut River and its tributaries. At this timne salmon have been restored upriver to the Wilder Dam, approximately 6.5 miles below the mouth of the Ompompanoosuc River. Future plans call for additional fish ladders and other access, which would extend the fishery throughout the basin. At this time no specific plans have been formulated to provide access for salmon above the Union Village Dam in Thetford.

The Ompompanoosuc Watershed is dominated by northern hardwoods, interspersed with open farmlands and small wetlands. This mixture of vegetation provides habitat for deer, moose, bear, songbirds, furbearing mammals, and waterfowl.

No state or federally listed threatened or endangered species have been identified in the Ompompanoosuc Watershed. However, transients such as the bald eagle and the peregrine falcon may visit the watershed during spring and fall migrations.

The State of Vermont owns two large parcels of land in Thetford. At the 262 ac. Thetford Hill State Park limited camping and hiking opportunities are available. The State also maintains the smaller Thetford Hill State Forest. The U.S. Army Corps of Engineers owns and maintains the Union Village Dam and Reservoir. They provide recreational facilities such as picnic areas, a fishing access and a swimming hole to the public.

There are two locally renowned geologic features in the town, the Covered Bridge Falls and the Lower Union Village Falls. The Upper Union Village Falls is a more regionally important geologic feature.

No prehistoric sites are currently known to exist in the Ompompanoosuc watershed. Based on knowledge of prehistoric man's habits and topographic features, the watershed is not suspected to contain any prehistoric archaeological sites.

Union Village and Thetford Center contain many historic structures. Each village contains a covered bridge, both of which are included on the Naitonal List of Historic Places. The Thetford Center Historic District is on the Vermont State list of historic places. The Peabody Library, also located in Thetford Center, is on the National List of Historic Places.

Factors Affecting Flooding

Obstructions to floodflows can have a tremendous impact on flood elevations. Obstructions can be either natural or man-made. Natural obstructions that impede floodflows may be sharp bends in stream alignment, channel constrictions due to topography of adjacent terrain, shoaling, rock outcrops in the stream or on the flood plain, ice jams, and vegetation such as grass, brush or trees. As floodflow is impeded, the velocity of the water decreases and the depth of flow increases; this results in flooding along streams. Man-made obstructions include bridges, culverts, dams, docks, levees, and earthfills. These man-made obstructions may severely hamper flow and cause a backwater condition, which creates more flooding than what would normally occur with only natural obstructions present.

During floods trees, brush, ice and other debris may be washed downstream to collect on bridges and other obstructions to flow. This is often referred to as a "log jam". As the floodflow increases, masses of debris break loose and a wall of water and debris surges downstream until another obstruction is encountered. Debris may collect against a bridge until the load exceeds its structural strength and causes the bridge to fail.

The limited capacity of obstructed bridges, debris plugs at bridge waterway openings, or a combination of these factors cause flooding upstream and erosion around bridge approach embankments. This erosion can cause damage to the overlying roadbed. In general, obstructions restrict floodflows and result in overbank flows. Unpredictable areas of flooding, destruction of or damage to bridges, and an increased velocity of flow immediately downstream can also occur from obstructed bridges.

It is impossible to predict the degree or location of debris accumulation. Therefore, in the development of flood profiles for this report, it was necessary to neglect the possibility of log-jams and the possibility of debris blocking bridges or culverts.

Flood Problems

The Town of Thetford has experienced severe flooding this century during November 1927, March 1936, September 1938, June 1973, and August 1976. The Town experienced major streambank and property damage during these floods.

Within the study area approximately four residential/commercial structures would experience flooding in the 100 year storm event. Additionally, two more structures are located within the 500 year flood plain. Most of the damage would be restricted to basement flooding.

There is a flood control structure in this watershed on the main stem of the Ompompanoosuc River, operated by the Corps of Engineers, at Union Village, known as the Union Village Dam. At the crest of the emergency spillway, the flood water would cover 720 acres. This flood plain is controlled by the Corps of Engineers, and is not included in this report.

Table 1 Characteristics of Potential Flood Damages
Town of Thethford, Vermont

Stream	Type of Land Use	Acres by Flood Frequency 100-Year	500-Year (Additional Acres)
Ompompanoosuc River	Open	66	0
	Woodland	57	0
	Residential and Structural	1	0
	Total	124	0
West Branch Ompaompanoosuc River	Open	4	0
	Woodland	33	7
	Residential and Structural	1	1
	Total	38	8

Figure 1. In Post Mills at cross section OM 28, in lower field upstream of Rt. 244 bridge, Rt. 244 in background on top of bank

Figure 2. On Rt. 132 at Abbott Brook crossing

Existing Flood Plain Management

In Vermont, municipalities have the authority to regulate development in flood hazard areas under Title 24 VSA chapter 91. Title 10 VSA chapter 32 authorizes the Secretary of the Agency of Natural Resources to designate flood hazard areas and to assist the towns with flood hazard regulations. Title 25 VSA subsection 4409 requires towns to submit a report to Environmental Conservation before issuing a permit for development in a designated flood hazard area.

Several other Laws and regulations administered by the state contain special requirements for development in flood hazard areas. Some of these are:

Act 250 (10 VSA chapter 151) administered by the Environmental Board and District Environmental Commissions;

Health Regulations administered by the Protection Division of the Agency of Natural Resources;

Storage of Flammable Liquids (20 VSA section 2721) administered by the State Fire Marshal;

Stream Alteration (10 VSA chapter 28) administered by the Department of Environmental Conservation;

Dam Construction (10 VSA chapter 29) administered by the Department of Environmental Conservation.

Alternatives for Flood Plain Management

Present Condition

Allowing the current flooding situation to continue is a possibility although undesirable alternative. Essentially the flood damages enumerated in Table 1 would continue. Lack of control over development in the flood plain could result in further encroachment by development with the accompanying increases in flood damages.

Land Treatment

Inclusion of conservation practices for erosion and runoff control in new developments and building areas would help to assure protection against induced flooding from this source. Control of erosion and sedimentation, to protect stream capacities is an important consideration.

Nonstructural Measures

Floodproofing of buildings and other high value property in the flood plain is a particularly appropriate measure for reducing losses to individual properties. A flood warning system or plan would be of limited value as a nonstructural measure because the time to respond with emergency protection activities is only a matter of a few hours. Relocation of some residences and buildings or acquisition to eliminate risks may be appropriate in some instances. The Town of Thetford plans to adopt formal flood plain regulations which will be very helpful in assuring development in the future will not sustain frequent, severe flood losses. The national flood insurance program has made affordable flood insurance available to flood-prone property owners through private underwriters. Owners of existing flood prone property should consider flood insurance as a means of reducing their flood loss risk. Other nonstructural approaches such as emergency preparedness and building or development codes should be considered.

Structural Measures

There appears to be little opportunity for modifying floods through headwater impoundments (dams) or channel enlargement.

Combinations of Alternatives

Several of the above alternatives could be combined in a number of ways to provide a plan to address the flooding problems.

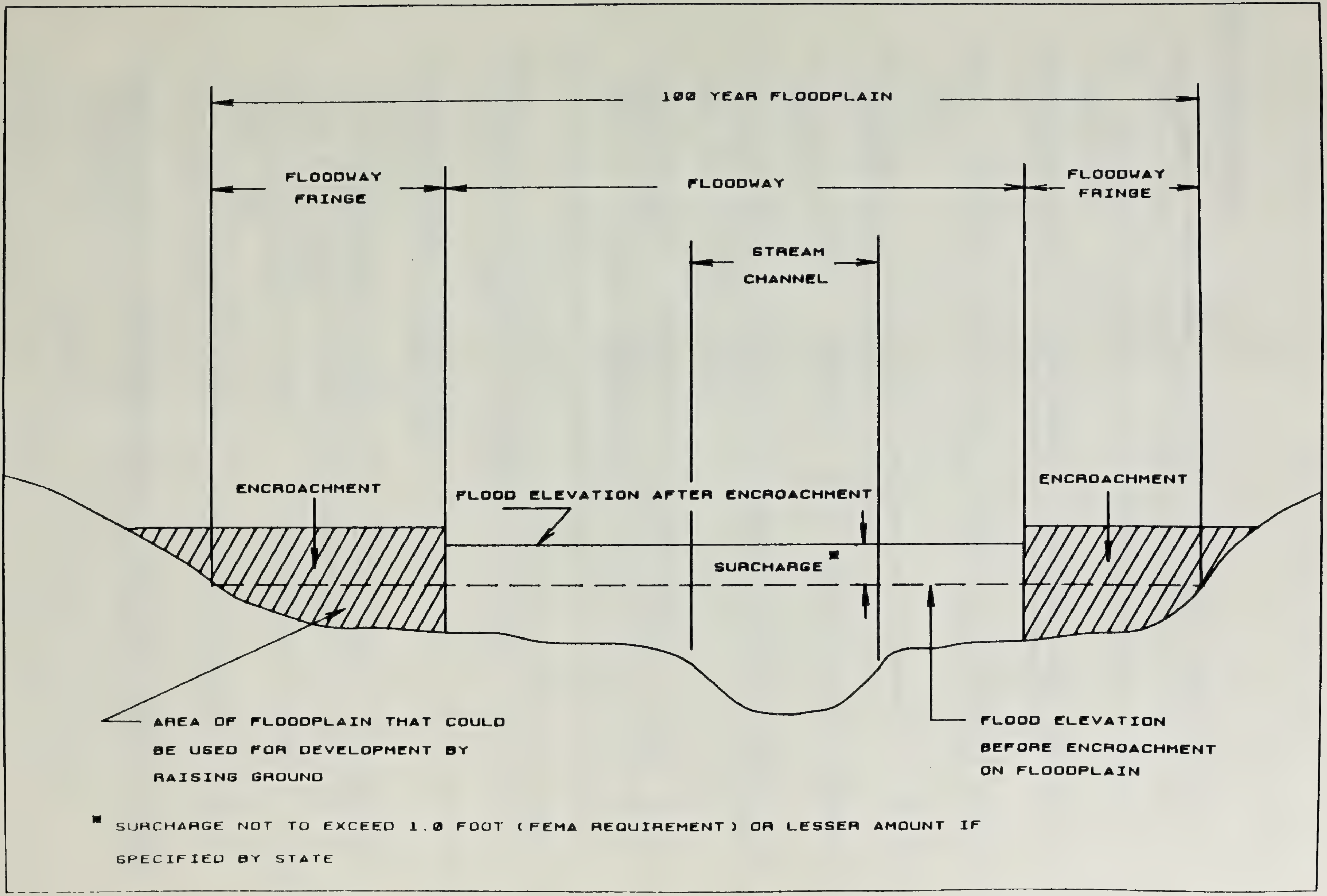
Floodway Determination

Any development activity that raises the elevation of the flood plain will restrict flow and increase flood heights. Communities have found benefits from allowing carefully controlled development to occur in the flood plain fringe provided resulting increases in flood hazard can be tolerated. The National Flood Insurance Administration uses the concept of floodway as an aid in evaluating such situations. This concept partitions the 100-year flood area into a floodway and a floodway fringe. The floodway fringe is the portion of the flood plain that can be completely obstructed without increasing the water-surface elevation of the 100-year flood more than one foot at any point. The floodway is the remaining portion of the channel and the flood plain (See Figure 3).

Flood Hazard Maps

The photomaps entitled "Flood Hazard Areas" (sheets 1 through 5 in Appendix A) show the 100-year and 500-year flood areas. These areas are depicted based on present land use and management conditions. The flood boundaries show the approximate location on the ground for general reference purposes. The 500-year flood boundary is to be interpreted as being close to the 100-year flood boundary where it is not separately mapped. The reason for this is that the valley side slopes along many reaches of stream are steep and the map scale small. This yields a 500-year boundary which is nearly contiguous with the 100-year boundary. Along such reaches it is therefore not mapped.

Flood boundaries were taken from the profiles and may not be mapped as accurately as the profiles themselves. For this reason it is recommended that you locate the property of interest on the profiles and establish the flood boundary (for desired frequency) on the property by field survey. Appendix A provides a tabulation of elevation reference marks that can be used in connection with this activity.



FLOODWAY SCHEMATIC

Figure 3

Glossary of Terms

backwater. High water caused by downstream obstruction or restriction, or by high stage on an intersecting stream.

BM. Benchmark of established elevation used for vertical reference.

bottom of culvert. Elevation of the lowest flow surface of a culvert (or pipe) through which flood flows pass.

cfs. Cubic feet per second - a unit of discharge that is equal to the flow of one cubic foot per second past a given point.

cross section. Shape and dimensions of a channel and valley perpendicular to the line of flow.

elev.-bridge deck. Elevation of a roadway across a bridge or culvert.

elev.-low chord. Elevation of lowest structural "beam" that limits the height of the bridge opening; or may indicate the top of a culvert opening.

elev.-low road. Elevation of low point on a roadway approaching or crossing a bridge or culvert - shown only if lower than elev.-bridge deck at a particular road section.

fps. Feet per second - units of velocity of stream flow.

flood. An overflow of lands not normally covered by water; a temporary increase in streamflow or stage; or the discharge causing the overflow or temporary increase.

flood frequency. An expression of how often a flood of given magnitude can be expected.
Examples:
10-year frequency flood. The flood which can be expected or exceeded on an average once in 10 years; or which would have a 10 percent chance of being equaled or exceeded in any given year.
100-year frequency flood. ....one percent chance....in any given year.

flood peak or peak discharge. Highest discharge attained during a flood.

flood plain or flood-hazard area. Lands adjoining a stream (or other body of water) which has been or may be covered with water.

flood profile or profile. A plotted or imaginary line defining the highest water surface elevations along a stream during a particular flood.

flood-hazard area. See flood plain.

flood routing. Computation of the changes in the rise and fall in streamflow as a flood moves downstream. The results provide hydrographs of discharge versus time at given points on the stream.

floodway. The portion of the stream channel and flood plain that must be kept free of encroachment to prevent flood stages from rising more than 1 foot higher than natural conditions.

frequency-discharge curve. A plotted line showing the recurrence interval (or flood frequency) of discharges at a stream gage, surveyed cross section, or other station along stream. (Used with a stage-discharge curve to determine the high water elevations resulting from selected flood discharges at that station on the stream.)

hydrograph. A curve showing the rise and fall of flood discharge with respect to time at a specific station on the stream.

land use. Classification of type of vegetation or other surface cover conditions on a watershed - used (with a similar classification of soils) to indicate the rate and volume of flood runoff.

NGVD. National Geodetic Vertical Datum, the normal standard of elevation reference.

peak discharge or flood peak. The highest rate of runoff (discharge) attained during a flood.

profile. See flood profile.

runoff. That portion of the total storm rainfall flowing across the ground or other surface and contributing to the flood discharge.

stage-discharge curve. A plotted curve showing elevations resulting from a range of discharges at a surveyed cross section, stream gage, or other point on a stream.

top of culvert. Elevation of the uppermost flow surface of a culvert (or pipe) through which flood flows pass.

TBM. Temporary benchmark used for vertical reference.

watershed. A drainage area which collects and transmits runoff to the outlet of the drainage basin.

REFERENCES CITED

1. Topographic maps; 7 1/2 minute series; scale, 1:24,000; U.S. Geological Survey, Washington, D.C. Chelsea, VT 1981; Veshire, VT 1981; Sharon, VT 1981; South Strafford, VT 1981.

2. Water Resources Data for New Hampshire and Vermont, Water Year 1977, Report No. NH-VT-77-1, U.S. Geological Survey, Boston, MA; August 1978.

3. A Unified National Program for Flood Plain Management, U.S. Water Resources Council, Washington, D.C., September 1979.

4. Regulation of Flood Hazard Areas to Reduce Flood Losses, (two volumes), U.S. Water Resources Council, Washington, D.C., 1971 and 1972.

5. Flood Plain Management Handbook, U.S. Water Resources Council Washington, D. C.; September 1981.

6. Guide for Flood and Flash Flood Preparedness Planning, U.S. Department of Commerce, National Weather Service, Silver Spring, MD, February 1977.

7. Flood Flow Frequency, Bulletin 17B, U.S. Water Resources Council, Washington, D.C., September 1981.

8. Computer Program for Project Formulation, Hydrology, Soil Conservation Service Technical Release No. 20, May 1983.

9. WSP2 Computer Program, Soil Conservation Service Technical Release No. 61, May 1976.

10. Floodway Determination Computer Program, Soil Conservation Service Technical Release No. 64, June 1978.

11. National Engineering Handbook, Section 4, Hydrology; U.S. Department of Agriculture, Soil Conservation Service; Washington, D.C.; November 1954, Revised August 1980.

12. Vermont Agency of Environmental Conservation. 1986, Vermont River Study, Waterbury, VT.

13. Vermont Fish and Game Department. 1962 Vermont Stream Survey. Montpelier, VT.

14. Flood Plain Information, Corps of Engineers.

APPENDIX A

USE OF APPENDIX

This appendix provides the data needed to use this report. Included in this appendix are:

<u>Flood Plain area Photomaps</u>

The Flood Plain Area Photomaps can be used for decisions where precise elevations are not required; for example, a brief check of the appropriate photomap may indicate that a proposed building site is obviously in or out of the flood plain.

<u>Flood Profiles</u>

On the reverse of each photomap are flood profiles, water surface elevation tabulations. These can be used with the photomaps to determine flood elevations at any point along the streams in the study area as follows:

1. On the appropriate photomap find the point on the stream where the proposed building is to be located; then scale the distance along the stream to the nearest cross section.

2. On the appropriate flood profile sheet, scale the distance determined in Step 1 from the cross section back to the original stream location, and read the elevation of the desired flood frequency line.

3. Transfer the elevation determined in Step 2 to the ground from the nearest established benchmark.

   If the point on the ground is at one of the surveyed cross sections, the elevation can be read directly from the tabulation of water surface elevations.

<u>Investigation and Analysis</u>

Investigations conducted and analysis used are described.

<u>Safety and Protection</u>

Steps that can be taken by individuals during a flood are discussed.

<u>Tabulated Data</u>

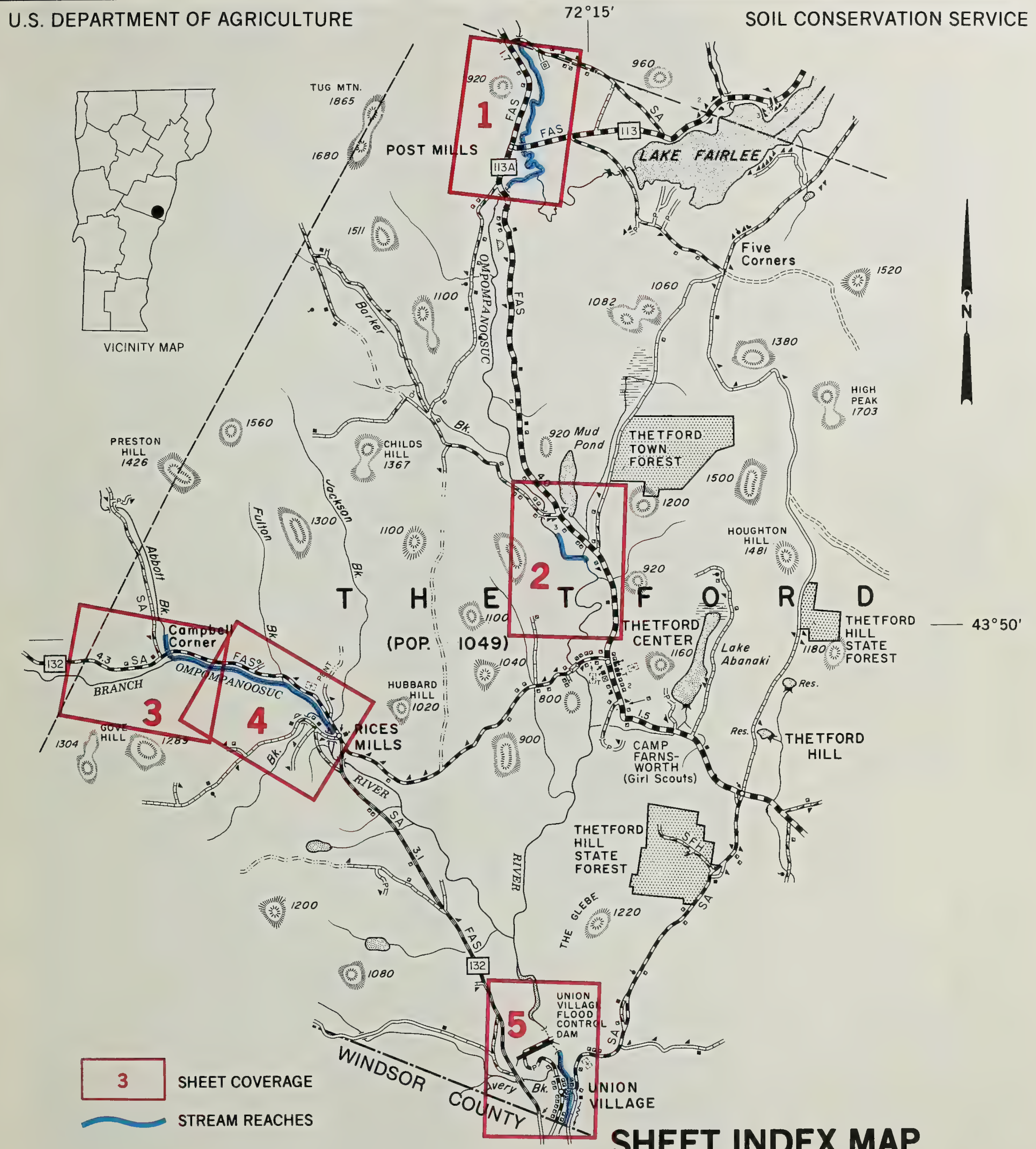
Tabulated elevations and discharges for each cross section of the 10, 50, 100, and 500 year storms.

<u>Benchmark Data</u>

Description and elevation of reference marks used in the study.

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



3 SHEET COVERAGE

STREAM REACHES

SHEET INDEX MAP

FOR THE

THETFORD FLOOD PLAIN MANAGEMENT STUDY

OMPOMPANOOSUC AND WEST BRANCH OMPOMPANOOSUC RIVERS

ORANGE COUNTY, VERMONT

0 1 2 MILES

0 1 2 3 KILOMETERS

BASE SOURCE:
ORANGE COUNTY GENERAL HIGHWAY MAP
PREPARED BY THE DEPARTMENT OF HIGHWAYS,
HIGHWAY PLANNING DIVISION, VERMONT.
POLYCONIC MAP PROJECTION BASED ON
U.S. GEOLOGICAL SURVEY MAPS.

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1991

AUGUST 1991 1003567-01

USDA SCS NATIONAL CARTOGRAPHIC CENTER FT WORTH TX 1991

LEGEND

- 100 YEAR FLOOD AREA
- 500 YEAR FLOOD AREA
- OM 31 — SURVEYED CROSS SECTION
- STREAM CHANNEL
- RM17 BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data

SCALE: 0 — 500 — 1000 FEET; 0 — 100 — 200 — 300 METERS (APPROXIMATE)

SPRING 1982 PHOTOGRAPHY BY VERNON GRAPHICS, INC

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

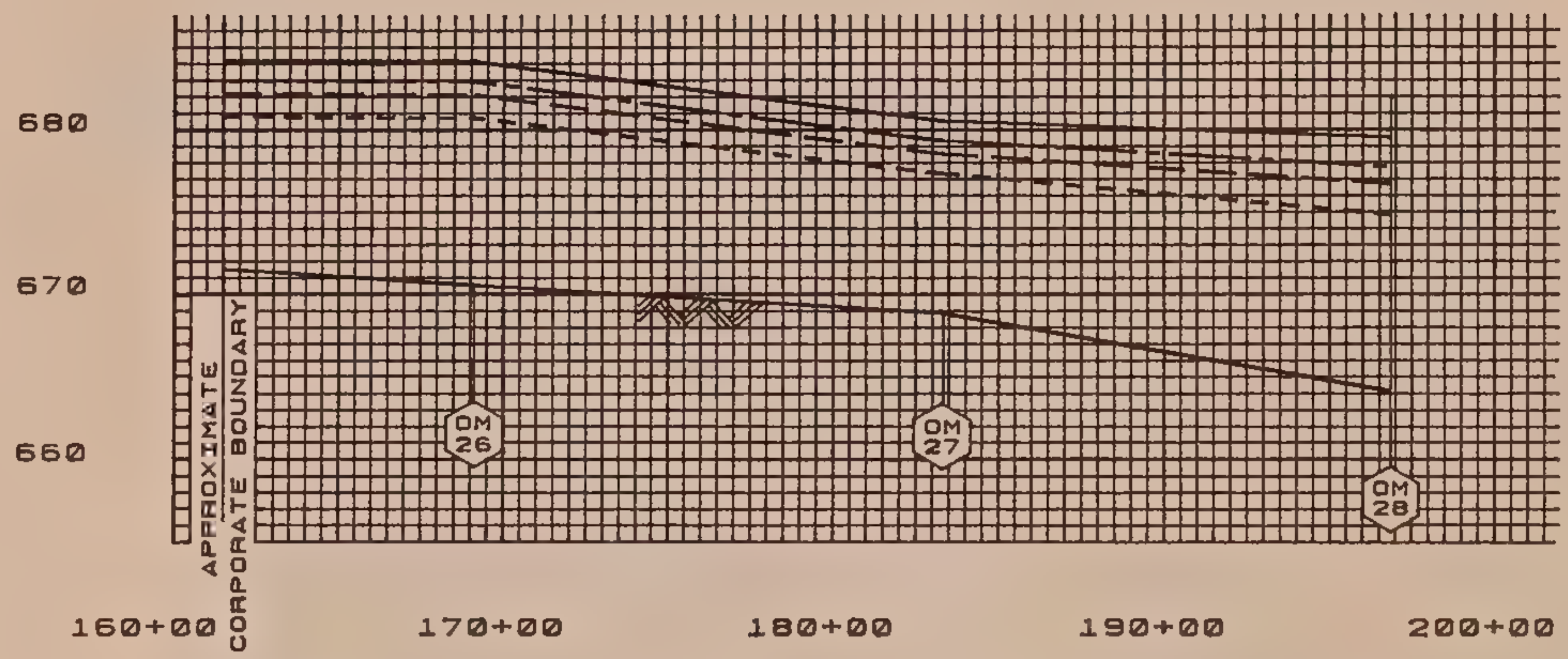
THETFORD
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

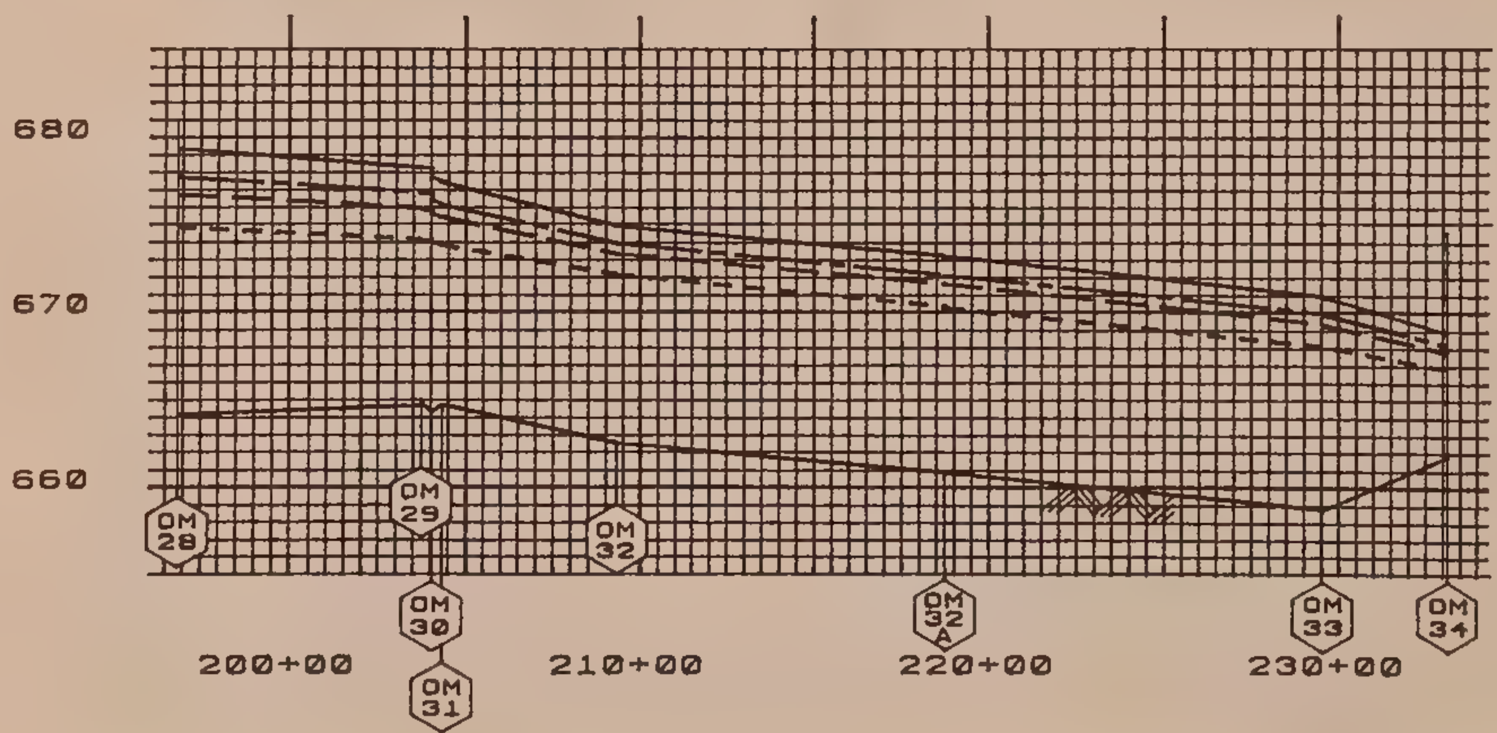
FLOOD HAZARD AREA

OMPOMPANOOSUC RIVER

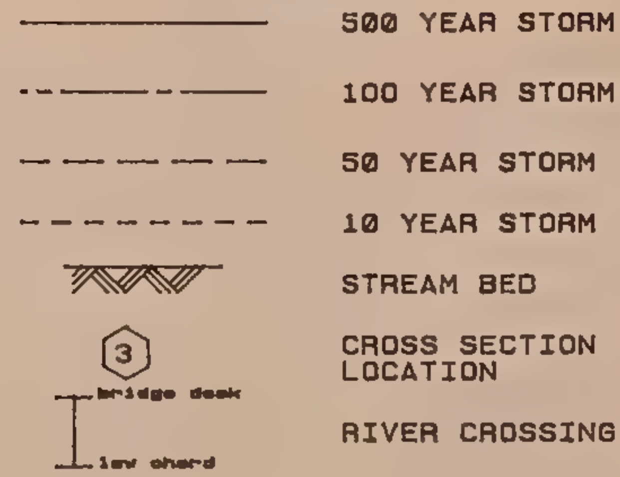
AUGUST 1991 1003567

OMPOMPANOOSUC RIVER





LEGEND



All elevations in feet (NGVD)

FLOOD PROFILES

OMPOMPANOOSUC RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
—THETFORD—
FLOODPLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

USDA SCS NATIONAL CARTOGRAPHIC CENTER FT WORTH TX 1991

LEGEND

100 YEAR FLOOD AREA

500 YEAR FLOOD AREA

OM 36 SURVEYED CROSS SECTION

STREAM CHANNEL

RM53 BENCH MARK

Note Flood Boundaries shown may vary from actual ground location See narrative for use of data.

SCALE 0 500 1000 FEET

0 100 200 300 METERS

APPROXIMATE

SPRING 1982 PHOTOGRAPHY BY VERNON GRAPHICS, INC

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

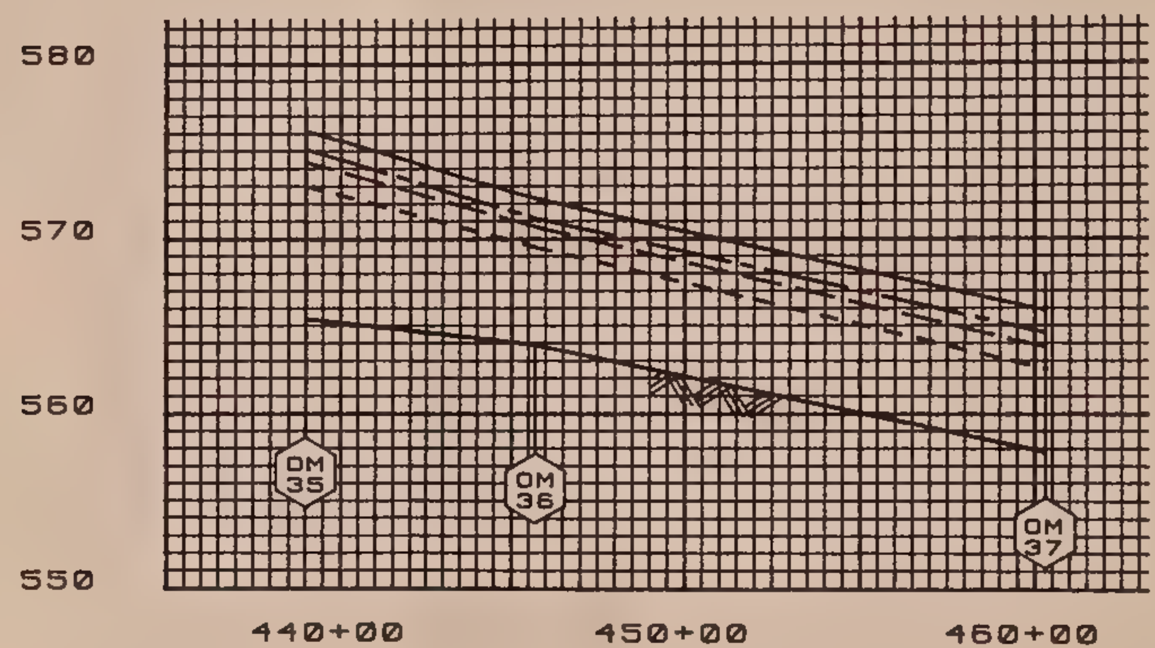
THETFORD
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

OMPOMPANOOSUC RIVER

AUGUST 1991 1003567

OMPOMPANOOSUC RIVER



LEGEND

500 YEAR STORM
100 YEAR STORM
50 YEAR STORM
10 YEAR STORM
STREAM BED
CROSS SECTION LOCATION
bridge deck
low chord
RIVER CROSSING

All elevations in feet (NGVD)

FLOOD PROFILES

OMPOMPANOOSUC RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
THETFORD
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

LEGEND

100 YEAR FLOOD AREA	STREAM CHANNEL
500 YEAR FLOOD AREA	RM9 BENCH MARK
WB 9 SURVEYED CROSS SECTION	Note: Flood Boundaries shown may vary from actual ground location See narrative for use of data

SCALE 0 500 1000 FEET
0 100 200 300 METERS
APPROXIMATE

SPRING 1982 PHOTOGRAPHY BY VERNON GRAPHICS, INC.

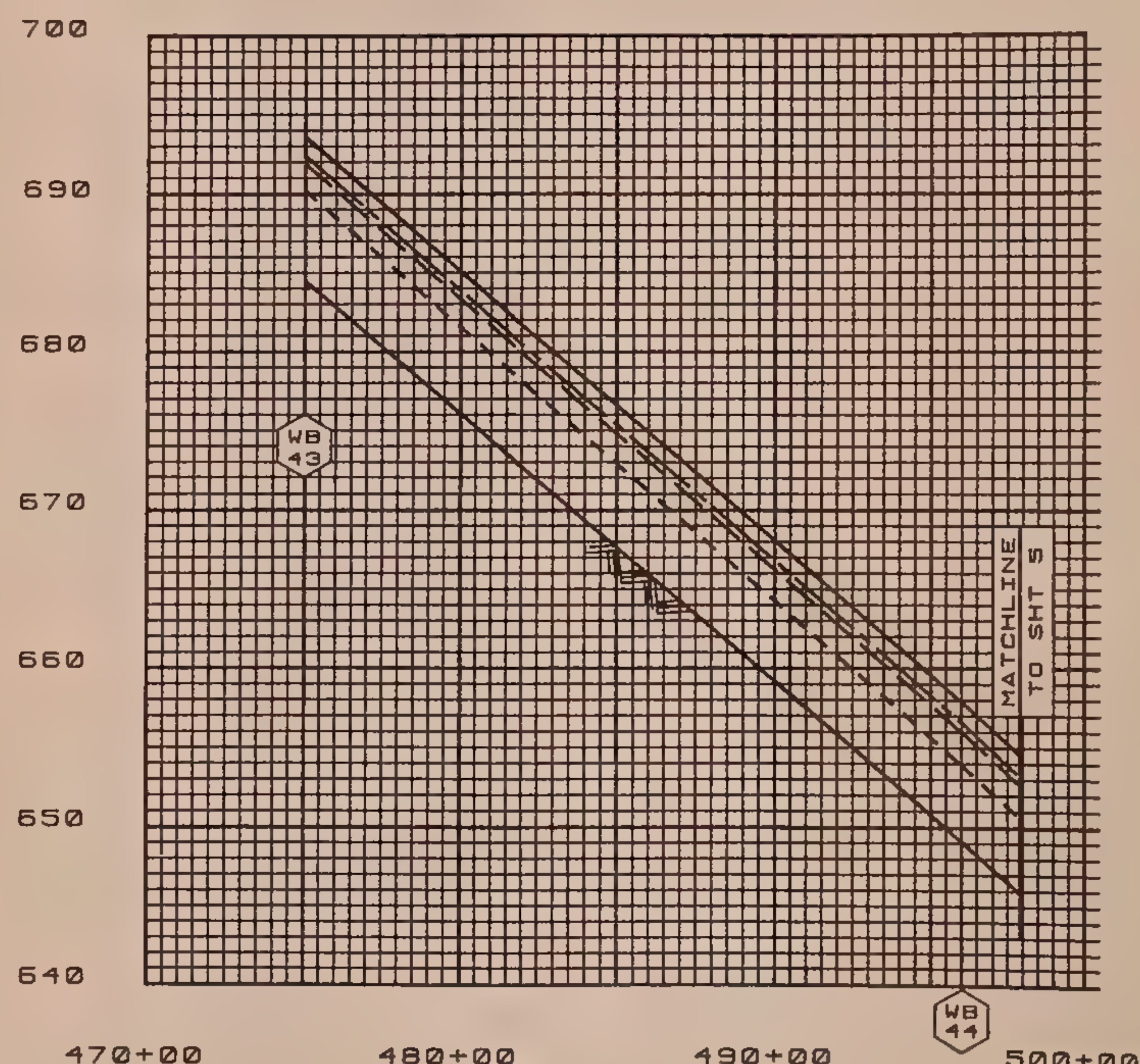
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
THETFORD
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

WEST BRANCH OMPOMPANOOSUC RIVER

All elevations in feet (NGVD)

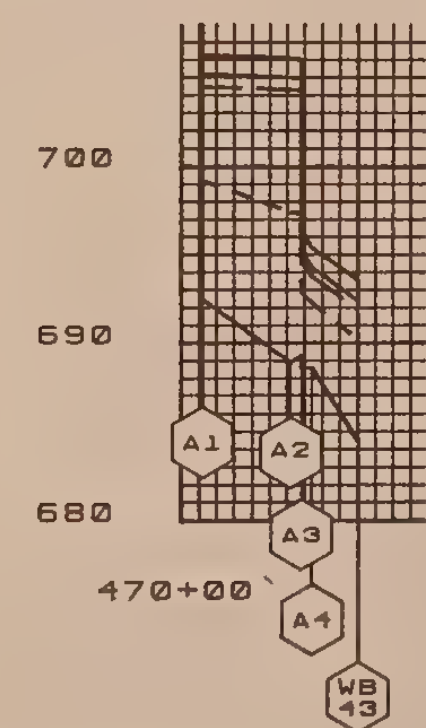
WEST BRANCH OMPOMPANOOSUC RIVER



LEGEND

- 500 YEAR STORM
- 100 YEAR STORM
- 50 YEAR STORM
- 10 YEAR STORM
- STREAM BED
- CROSS SECTION LOCATION
- RIVER CROSSING (bridge deck / low chord)

ABBOTT BROOK



FLOOD PROFILES

WEST BRANCH OMPOMPANOOSUC RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
— THETFORD —
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

LEGEND

100 YEAR FLOOD AREA

500 YEAR FLOOD AREA

WB 46 SURVEYED CROSS SECTION

STREAM CHANNEL

RM6 BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data

SCALE 0 500 1000 FEET
0 100 200 300 METERS
APPROXIMATE

SPRING 1982 PHOTOGRAPHY BY VERNON GRAPHICS, INC

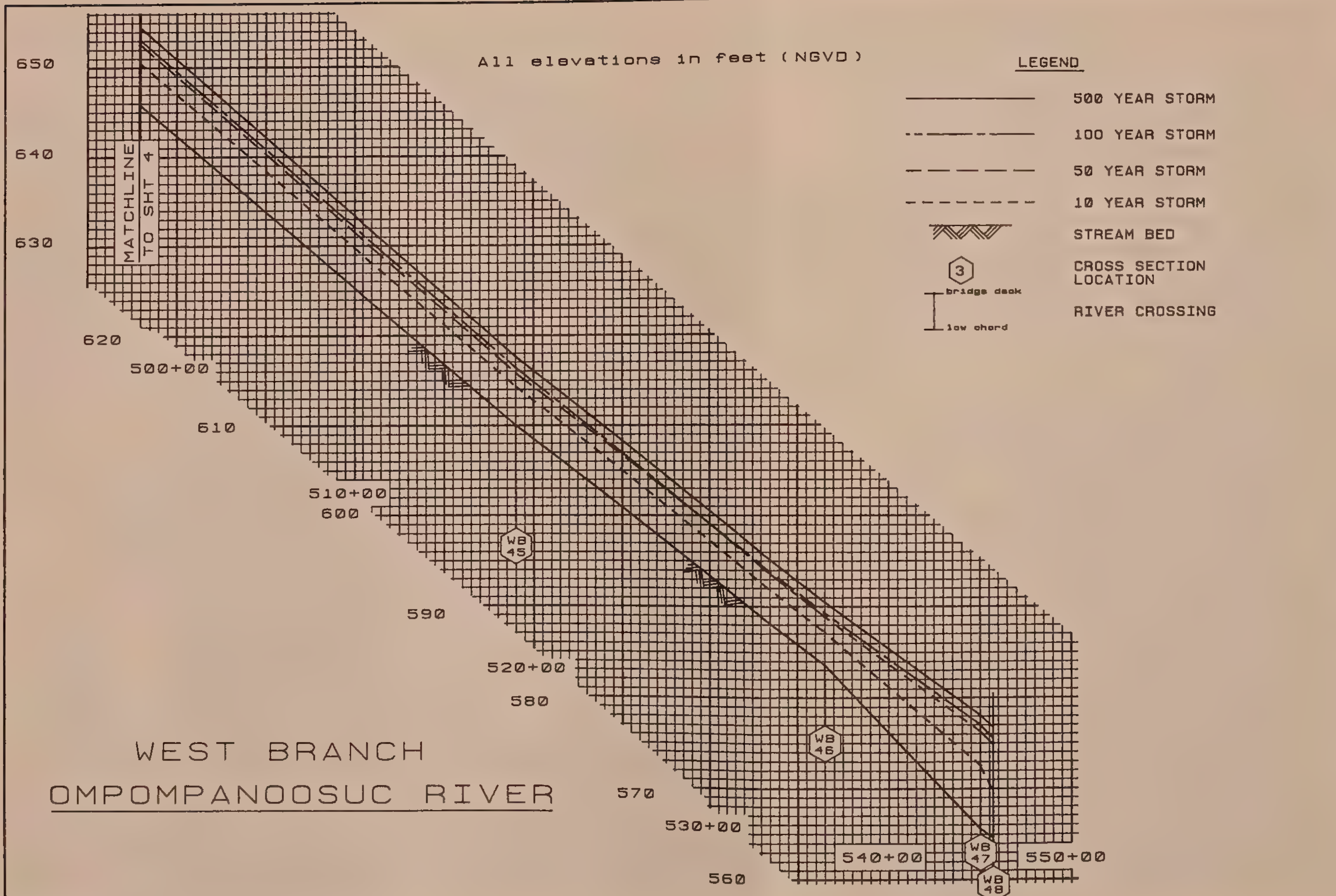
U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
THETFORD
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

WEST BRANCH OMPOMPANOOSUC RIVER

SHEET 4 OF 5

USDA SCS NATIONAL CARTOGRAPHIC CENTER FT WORTH TX 1991
AUGUST 1991 1003567

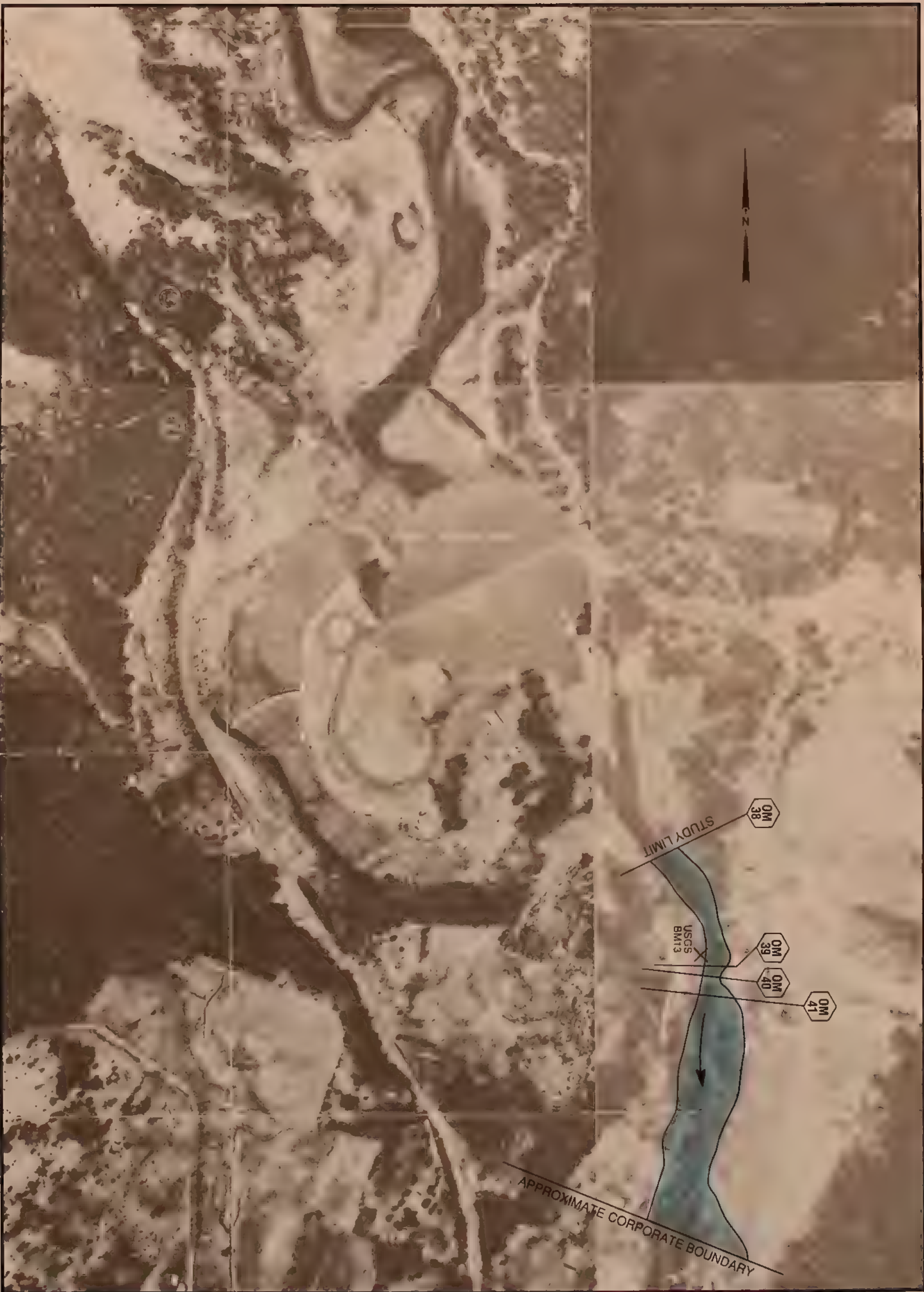


FLOOD PROFILES

WEST BRANCH OMPOMPANOOSUC RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

— THETFORD —
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT



LEGEND

- 100 YEAR FLOOD AREA
- 500 YEAR FLOOD AREA
- UV 3 — SURVEYED CROSS SECTION
- STREAM CHANNEL
- ✕ BM13 BENCH MARK

Note: Flood Boundaries shown may vary from actual ground location. See narrative for use of data

SCALE: 0 — 500 — 1000 FEET; 0 — 100 — 200 — 300 METERS (APPROXIMATE)

SPRING 1982 PHOTOGRAPHY BY VERNON GRAPHICS, INC

SHEET 5 OF 5

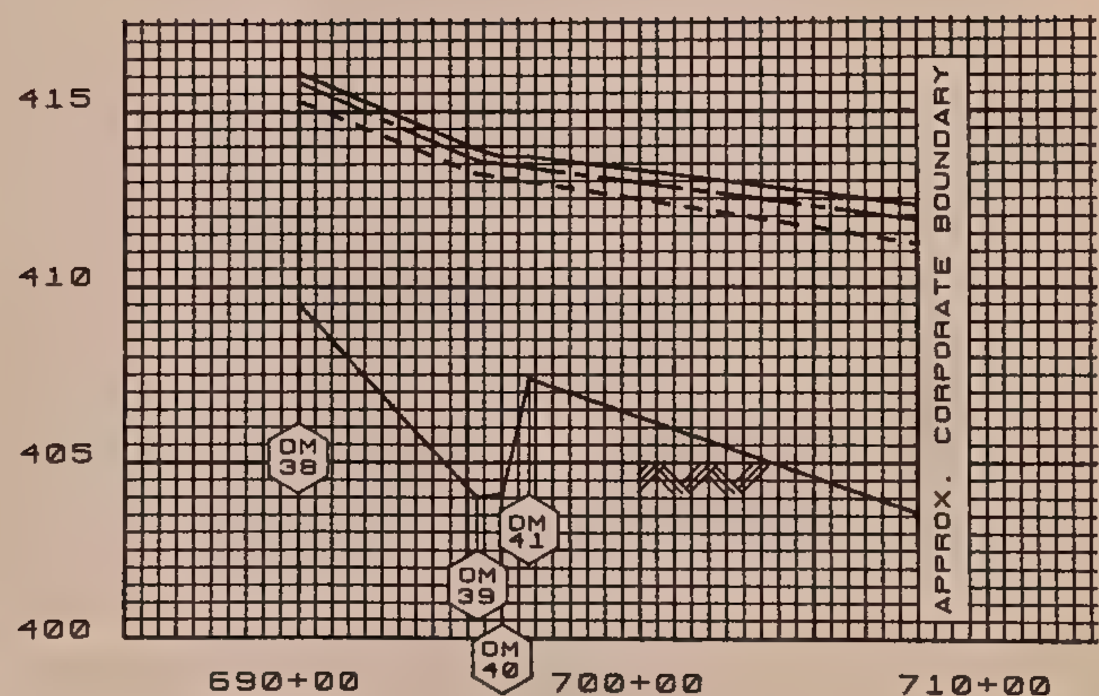
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

THETFORD
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

FLOOD HAZARD AREA

OMPOMPANOOSUC RIVER

OMPOMPANOOSUC RIVER



LEGEND

500 YEAR STORM

100 YEAR STORM

50 YEAR STORM

10 YEAR STORM

STREAM BED

CROSS SECTION LOCATION

bridge deck

low chord

RIVER CROSSING

All elevations in feet (NGVD)

FLOOD PROFILES

OMPOMPANOOSUC RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

THETFORD
FLOOD PLAIN MANAGEMENT STUDY
ORANGE COUNTY, VERMONT

Investigations and Analysis

Approximately 8 miles of differential levels to establish vertical control and 53 cross sections were surveyed for this study. Surveys are referenced to National Geodetic Vertical Datum (NGVD) of 1929. Reference mark Descriptions and Elevations are listed in preceding tables and located on appropriate photomaps.

Flood runoff volumes and flow rates were developed using the SCS computer model described in Technical Release No. 20 (Reference No.8). Flow-frequency values from this hydrologic model were adjusted as necessary in analyzing them along with values from other flood insurance studies. Flood plain geometry and hydraulic characteristics were acquired by field surveys along the river systems. Flood-frequency surfaces were computed using the adjusted flows from the hydrologic model as inputs to water surface profile development, using the Soil Conservation Service's Technical Release No. 61 (Reference No.9). The products of these analyses are the basis for much of the boundary elevation and profile information contained in this report. This report's information reflects coordination with evaluations made by others.

The flood stages provided for selected storm frequencies should be considered as minimum elevations for the prescribed uses of this report. Certain indeterminate factors and conditions affecting future flood flows could cause higher flood stages than indicated. These include ice and debris, clogging of bridges and culverts, sediment, ice and debris jams along the channel and flood plain, and changes in the vegetative character of the channels and flood plain.

Analysis of the hydraulic characteristics of streams were carried out using the SCS computer program WSP-2 (Ref. 9). Cross section data for the streams and structural geometry of bridges and culverts were obtained by transit surveys. From stage-discharge curves, elevations and flood boundaries were determined at the cross sections. Straight line interpolations of the elevations were used for flood profiles between cross sections. Flood boundaries between cross sections were drawn on the photomaps using USGS topographic maps and aerial photos as a guide. The results were reviewed with state and town officials to eliminate any obvious errors.

The photomaps were assembled as strips from 1:5000 scale, Vermont Mapping program, Orthophoto Maps by the USDA-SCS Fort Worth, Texas Cartographic Unit.

Safety and Protection

This flood plain management study is an aid to persons living in flood prone areas. If your home is within the flood plain, the following information should serve as a guide for dealing with floods.

Being well informed is your best protection. It is extremely important to know <u>where</u> to go in the event of a flood. Remember that roads are often built in valleys where floodwaters will most likely go. You should reach higher ground, and it may be easier and safer to do this on foot, rather than by car.

The major causes of floods are melting snows and rainfall. Listen to the weather reports and be aware of the chance of flooding. <u>Never</u> ignore a flood warning. Listen for emergency instructions and <u>follow</u> instructions given.

If it is necessary for you to evacuate your home, do so quickly and cautiously. Follow evacuation instructions that are given. Do not try to take all of your belongings with you. Take necessary personal items such as eyeglasses, medicines, flashlights, a small supply of canned food, a can opener and several blankets.

If you are traveling by car you may encounter these hazards:

- washed-out roads or bridges
- undermined roadway
- landslides
- fallen rocks
- downed powerlines
- floating debris

Watch out for these hazards carefully.

If it is not necessary to evacuate your home, there are precautions you should proceed with.

Fill large containers with water and after doing so shut off the main water valve to protect the clean water already in your water system. Be certain to shut off your water heater since no water will be going to it.

As long as electric service is available it may be used safely unless the main circuits are flooded. In such a case you will reduce the risk of electrical shock and short circuits if you turn the power off. Do not touch the switch if you are wet or standing in water. Unless you detect a gas leak, you may continue to use gas systems.

Be aware that floods often produce fire hazards. Watch for broken or leaking gas or oil lines, flooded electrical circuits, flooded furnaces and other appliances, and inflammable or explosive materials which may come from upstream.

Anchor or move inside any belongings such as trash cans, toys, lawnmowers, etc. They may become hazards to people downstream if they are washed away.

Move livestock to high, open ground and if possible keep them from drinking flood water or eating feed soaked with flood water.

The following items could help improve your chances of survival if a flood occurs:

- portable radio and spare batteries
- first aid kit
- flashlights and spare batteries
- foods which require little or no cooking and no refrigeration
- blankets
- rope
- hand tools
- drinking water

Precautions taken to reduce losses from flooding are called floodproofing.

The basement walls of your home are probably not built to withstand the additional pressures of water-soaked soils. You will have less damage if you allow floodwaters to come in. When you receive a flood warning, remove articles from the basement and open a basement window. Fuse boxes and other equipment should not be located in the basement.

Floodproofing for homes with adequately reinforced basement walls could include: sealing cracks in walls and floors with hydraulic cement, installation of a sump pump with a reliable power source, placing heavy screens over windows to prevent breakage from floating objects, and placing valves on main drain lines to prevent backup of water.

It is important to remember that floodproofing can help reduce damages, it does not make it safe to remain in your home during a flood.

After a flood, reenter buildings with caution. Watch for fire hazards, displaced wild animals and falling debris. Do not use appliances until they have been checked for damage. Do not use any food or water which may be contaminated.

Normal home insurance does not cover flooding. Ask your insurance agent about federally subsidized flood insurance. Not all agents handle flood insurance and you may have to contact several of them.

Many people are hurt or killed during or after a flood by their own carelessness. Know before hand what to do if a flood occurs. Your local Civil Defense Agency can help you with any questions you may have.

OMPOMPANOOSUC RIVER
Elevation (NGVD), Velocities (FPS), Discharges (CFS)

CROSS SECT.	CHANNEL ELEV.	10-YR STORM ELEV. FT.	10-YR VEL FPS	10-YR DSCHG CFS	50-YR STORM ELEV FT	50-YR VEL FPS	50-YR DSCHG CFS	100 YR STORM ELEV FT	100 YR VEL FPS	100 YR DSCHG CFS	500-YR STORM ELEV FT	500-YR VEL FPS	500-YR DSCHG CFS
OM26	670.5	680.7	3.2	2750	682.1	3.8	4600	682.9	4	5700	684.1	4.4	7750
OM27	668.8	677.3	1.4	2600	678.5	1.6	4400	679.3	1.6	5450	680.5	1.6	7400
OM28	659.1	674.8	1	2450	676.7	1	4150	677.7	1	5150	679.3	1.1	7000
OM29	664.8	674.1	5.2	2450	675.9	6.4	4150	676.8	6.9	5150	678.2	7.7	7000
OM31	664.7	673.8	5.4	2450	675.4	6.8	4150	676.1	7.4	5150	677.4	8.3	7000
OM32	662.5	672.1	1.4	2450	673.3	1.7	4150	673.9	1.8	5150	674.9	2.1	7000
OM32A	660.8	670.3	1.6	2550	671.6	1.9	4350	672.1	2	5350	673.2	2.2	7300
OM33	658.7	668.1	3.4	2550	669.3	4.1	4350	669.9	4.4	5350	670.9	4.7	7300
OM34	661.8	666.8	8.1	2550	667.7	9.3	4350	668.1	9.8	5350	668.8	10.8	7300
OM35	565.4	573	5.6	2700	574.4	6.4	4650	575.1	6.7	5900	576.2	7.5	8450
OM36	563.9	569.5	3.8	2700	570.7	3.9	4650	571.2	4.1	5900	572.3	4	8450
OM37	557.8	562.5	10.2	2850	563.8	11.9	4900	564.6	12.6	6200	565.9	13.6	8850
OM38	409.5	415.2	-	-	415.7	-	-	415.8	-	-	416	-	-
OM39	404	413.2	-	-	413.4	-	-	413.5	-	-	414.8	-	-
OM40	404.1	413.1	-	-	413.4	-	-	413.5	-	-	414.7	-	-
OM41	402.4	413	-	-	413.8	-	-	413.9	-	-	414.7	-	-

ABBOTT BROOK AND WEST BRANCH OMPOMPANOOSUC RIVER
Elevation (NVGD), Velocity (FPS), Discharge (CFS)

		10-YR STORM			50-YR STORM			100-YR STORM			500-YR STORM		
CROSS SECT.	CHANNEL ELEV	ELEV FT	VEL FPS	DSCHG CFS	ELEV FT	VEL FPS	DSCHG CFS	ELEV FT	VEL FPS	DSCHG CFS	ELEV FT	VEL FPS	DSCHG CFS
A1	692.5	699.2	4.9	750	704.5	1.9	1700	705.2	2	2000	706.3	2.3	3100
A2	688.9	697.4	4.7	750	704.3	2.3	1700	705	2.5	2000	706.1	3	3100
A4	688.6	692.3	7.4	750	693.8	9.1	1700	694.3	9.9	2000	695.4	11	3100
WB43	684.5	690.2	6.4	1850	691.9	7.5	4150	692.4	7.9	5200	693.6	8.6	7700
WB44	649.1	653.9	6.2	1850	656	8.2	4150	656.6	8.9	5200	657.9	10.1	7700
WB45	610	614.3	5.9	1850	615.8	8.4	4150	616.4	8.8	5200	617.6	10.3	7700
WB46	583.6	587.2	6.2	1850	588.9	7.4	4150	589.3	8.2	5200	590.5	8.9	7700
WB47	565.6	572.5	9.6	2050	576.3	9.7	4550	577	10.5	5700	578.1	11.6	8450
WB48	564.6	569.8	12.5	2050	574.9	11.4	4550	575.6	11.9	5700	576.8	12.8	8450

Town of Thetford

Tabulation of Elevation Reference Marks

Reference Mark	Description and Elevation (ft. msl. NGVD 1929)
#1	From the Norwich-Thetford Town Line; go northwesterly on Vermont Route 132 for 2.8 miles to junction of town highway to NW; thence northwesterly along Town Highway about 0.4 miles to town highway to east; thence easterly along Town Highway about 0.1 mile to bridge over small brook; at northeast corner of bridge on east abutment; chiseled square. Elevation 578.595.
#4	From the Norwich-Thetford Town Line; go northwesterly on Vermont Route 132 for 3.3 miles to power and telephone line crossing; on boulder in ditch line on north side of road; chiseled square. Elevation 602.690.
#6	From the Norwich-Thetford Town Line; go northwesterly on Vermont Route 132 for 3.7 miles to bridge over Fulton Brook; at southeast corner on top of concrete bridge railing a chiseled square. Elevation 627.858
#8	About 0.6 mile east of Campbell Corner and 3.9 miles northwesterly of the Norwich Thetford Town Line; a nail in utility pole #12-2A on north side of highway. Elevation 655.488
#9	0.4 mile east of Campbell Corner; 4.2 miles northwesterly of the Norwich-Thetford Town Line; a nail in utility pole #12-4/4 on south side of highway. Elevation 664.008
#10	On Vermont Route 132, 0.2 mile east of Campbell Corner; 4.3 miles northwesterly of the Norwich-Thetford Town Line; a nail in utility pole #21-8A on south side of highway. Elevation 684.246

Tabulation of Elevation Reference Marks(Cont'd)

Reference Mark	Description and Elevation (ft. msl. NGVD 1929)
#11	On Vermont Route 132, 300 feet east of Campbell Corner near field drive just east of Abbott Brook on north side of highway; 4.4 miles north-westerly of the Norwich-Thetford Town Line; a nail in trunk of 8" eastern cottonwood 6 inches above ground. Elevation 706.338
BMC3-1828	On the Thetford-/West Fairlee Town Line at the west side of the intersection between Route 113 and connector road to Route 244; a USGS Tablet on top of a large boulder. Elevation 719.195
M13	From the Thetford-West Fairlee Town Line; go south on Route 113 for 0.2 miles; a nail in utility pole #159/6/204 on the west side of the road. Elevation 689.98
RM14	From the Thetford-West Fairlee Town Line; go south on Route 113 for 0.35 mile; a nail in utility pole #153/234 on the east side of the road. Elevation 702.19
RM15	From the Thetford-West Fairlee Town Line; go south on Route 113 for 0.6 mile; a nail in utility pole #145/6/157 on the west side of the road. Elevation 683.44
RM16	From the intersection of Routes 113 and 244 in Post Mills; go south for 0.3 mile on route 113 to a concrete bridge; a chiseled square on top of the north upstream wingwall. Elevation 669.76
RM17	From the intersection of Routes 113 and 244 in Post Mills; go south approximately 0.2 mile on Route 113; a nail in 24 inch ash tree at the northwest end of the dam upstream of the bridge. Elevation 669.76
RM17A	From the Route 144 bridge in Post Mills; go south along the Ompompanoosuc River approximate-ly 400 feet, a nail and disk in the south side of an 18 inch elm on the east bank of the river. Elevation 671.57

RM18	From the intersection of Routes 113 and 244 in Post Mills; go south for 0.15 mile on Route 113; a nail and disk in utility pole #65 at the north side of the Meeting Hall parking lot. Elevation 695.79
RM19	Approximately 300 feet east from the intersection with Route 113 on the Route 244 bridge over the Ompompanoosuc River a chiseled square on the downstream westerly wingwall. Elevation 691.07
RMBRZ	From Thetford Center go north on Route 113 approximately 1.3 miles then 600 feet west on Sawnee Bean Road to the bridge over Ompompanoosuc River; a State of Vermont Tablet on the upstream easterly wingwall. Elevation 605.61
RM53	From the Sawnee Bean Road bridge over the Ompompanoosuc River go south on a private road just west of the bridge for approximately 0.2 mile and 380 feet south of a road gate; a nail and disk in a 10" ash 25 feet east of the edge of the road. Elevation 576.13
RM54	From the Sawnee Road bridge over the Ompompanoosuc River, go south on a private road just west of the bridge approximately 0.3 mile to an old ford crossing; a nail and disk in a 10 inch ash on the west side of the river. Elevation 570.17
UV112	From Thetford Center go north on Route 113 approximately 0.9 mile to the intersection with five corners road; then west across field in hedge row near streambank a U.S. Army Corps of Engineers Monument stamped UV112. Elevation 571.09
USGS-BM13	100 feet upstream from covered bridge at Union Village and 17.5 feet from corner building, a U.S. Geological Survey Marker in a 9 inch square concrete post. Elevation 417.56